IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *With international search report.*

For two-letter codes and other abbreviations. refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Data Processing Apparatus

Field of the invention

This invention relates to a data processing apparatus.

Background

Traditional computer architectures systems are well suited to processing data according to predefined algorithms such as by a conventional Von Neumann digital processor. However, such conventional data processing is not generally suited to problems involving analog signals, pattern matching and asynchronous or real-time signals, and also in noisy or chaotic systems or those where the algorithm to be used is unknown and is to be determined by processing of the data.

Neural nets have been proposed for pattern recognition and other purposes but they are not able to adapt rapidly to changes in the system parameters and require extensive training.

The present invention seeks to provide an improved general purpose data processing apparatus which overcomes these difficulties.

Summary of the invention

According to the present invention there is provided data processing apparatus comprising: a backplane for data signals in a plurality of different formats, a plurality of adaptive filters to receive data signals in respective different formats from the backplane, a plurality of processors to receive data derived from the backplane in said different formats respectively, at least one of the processors being operable to process data from one of the filters and being responsive to the outcome of data filtering performed by at least one other of the filters to adapt the processing performed thereby.

The apparatus according to the invention is not limited to any particular technology, medium or transport mechanism for the signals of different formats, which for example, can be optical, electrical, chemical or any other suitable form.

The use of signals in different formats allows data to be analysed from different perspectives so that a processor operable with signals in a first format may be configured to perform efficient processing on the basis of an analysis of the signals in a second different format.

To this end, a feedback path may be provided to adjust filtering characteristics of at least one of the adaptive filters as a function of the outcome of the processing performed by at least one of the processors.

The feedback may be configured to achieve homeostasis.

At least one of the processors may be operable to carry out processing according to a plurality of different algorithmic processes and to select one of them according to the outcome of the processing performed by another of the processors. Thus, the processing of data in one of the formats can be used to optimise processing of the data in another of the formats so as to provide more efficient algorithmic processing of the data.

Brief description of the drawings

In order that the invention may be more fully understood an embodiment of thereof will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic block diagram of an architecture for a data processing apparatus according to the invention;

Figure 2 is a schematic diagram of operation of the architecture shown in Figure 1;

Figure 3 is a schematic illustration of the relationship between an entity and its attributes;

Figure 4 is a schematic diagram of how entities are related through their attributes; and

Figure 5 is a schematic block diagram of a code breaking machine in accordance with the invention.

Detailed description

Referring to Figure 1, the data processing apparatus includes an array of sensors 1 which provide signals in a number of different formats relating to an external environment in response to inputs I. The sensors 1 produce outputs in different signal formats which are fed into a multi-format communications backplane 2. As explained in more detail hereinafter, the backplane 2 acts as a conduit for signals in different formats, such as optical, electrical, chemical.

A series of connections 3 extend from the backplane 2, to individual adaptive filters 4 which individually recognise some physical property of signals on the backplane 2. For example, one of the filters 4 may be an optical filter configured to recognise a particular optical characteristic of signals from the backplane whereas another one of the filters 4 may be an electrical filter for filtering electrical signals from the backplane. The filters may recognise characteristics such as frequency or some other characteristics such as the signal's chaotic state.

Each of the adaptive filters 4 has an associated processor 5 capable of processing signals in the individual formats handled by the filters. The result of the filtering and processing is fed back on path 6 to the backplane 2 so that the processed signals can be then pass to another filter-processor combination 4, 5 for further processing.

As shown in Figure 1 processor 5a produces an output 6a which passes out of the apparatus. Additionally, an array of transducers/effectors 7 can be provided, responsive to the outputs of the processors 5 to provide an output 6 which can be used to control other processor/filter combinations or communicate with external apparatus.

In operation, inputs I are present in the environment, are detected by the sensor array 1 so as to place signals on the universal backplane 2. The signals may be of any suitable form in different formats, as previously described, and the role of the backplane 2 is to ensure that all of the processor/filter components can receive signals in corresponding appropriate formats from the backplane. The formats may

include optical, photonic, liquid or gaseous movement, changes of state and the connections may be achieved in free space or constrained for example in a fibre or tube. Modes of communication may be analog or digital in the backplane 2. Preferably, the modes of communication in the backplane are inherently multi-modal. For example, an optical fibre can transmit both on many wavelengths and either analog or digital signals. The backplane 2 may perform differential attenuation of signals and may exhibit different temporal characteristics to different signals.

The adaptive filters 4 connected to the backplane 2, select from the signals of different formats those that they can recognise. This will depend on the physical properties and the algorithmic nature of the signal. For example, an optical filter 4 can be set to a particular wavelength, signal threshold and window time, thus acting as a filter element tuned to particular signals. The filter can also act as a buffer by looking only for signals that exhibit a particular short term periodicity. The filter would respond purely to analog signals at the same wavelength and thus some signals from the backplane can strongly stimulate certain filters and weakly or differentially be detected by other ones of the filters.

The filters 4 are adaptive and thus change their filtering properties according to the signals that are acted upon by them. The filtered signals 6 are used to adjust the characteristics of the filters 4 adaptively.

The more that a processor 5 responds to a particular filtered signal, the stronger should be the reinforcement. The filter 4 can be considered as accepting signals inside certain bounds which the overall apparatus can alter. For example, bounding of the filtered signals in terms of wavelength, threshold and window duration can be carried out. The effect of the feedback to the adaptive filters 4 is either to increase or decrease bounding of the filter. The exact mechanism will depend on the processor 5 and the filter 4. The goal is to reinforce desirable behaviours. The bounding could even initially increase response strength and then decrease so that the filter 4 self-tunes to an optical response level.

The processors 5 are configured to receive filtered inputs from the filters 4 and to carry out an algorithmic process to provide an output. The processors 5 may take many different forms. They may comprise conventional digital processors or can operate according to an analog computation, involve interaction with humans, be a wet chemical, electronic or other action. The processors 5 may include individual memories to store precise, imprecise or temporally failing data. Unlike a conventional Von Neumann processor, there may not be a requirement for a dedicated conventional memory store, but instead, memory elements may be distributed throughout the processor architecture, for example in the backplane 2 or the filters 4.

Figure 2 provides an insight into how the architecture will operate to produce an effective output 6, having been stimulated at its input 1a.

In Figure 2, a number of vectors are shown, as follows:

P	Vector that represents a problem space
K	Vector that represents a knowledge space
S	Vector that represents a solution space
B	Vector that represents a bounding function
erf I	Vector that represents an error function

The apparatus in basic terms produces a solution, or a manipulation of an effector, by operating a transform from the problem space P which acts with the knowledge space K to create a solution or a number of solutions in the solution space S. The bounding vector B is used to bound the solution.

The error function erf I is used to stimulate the machine randomly and/or synchronously in order to prevent it from falsely locking into a limited solution space. Although in Figure 2, the process is presented in two dimensions for each of explanation, it will be understood that the architecture of Figure 1 has the capability to operate in N dimensions.

Each element of the P, K, and S vectors consist of a single entity which has a number of attributes associated with it, as indicated in Figure 3. The machine builds its knowledge space K by creating entities and associate attributes with each entity. The machine links the attributes, which are not permanent in time, and the links are continually reviewed and reinforced as appropriate. If the links are used often, then they are reinforced because it indicates a strong association between the entity and the attribute. If the link is used less often, it is weak and is removed relatively quickly.

Figure 4 illustrates schematically how entities are related through their attributes. Figure 4 illustrates entity groups E1, E2, E3, and E4 and E5.

Knowledge K is associated with an entity E, where:

E1 represents a dog
E2 represents a cat
E3 represents a mink
E4 represents a car
E5 represents a locomotive

An attribute that could link groups E1, E2 and E3 is fur. An attribute that could link group E4 and E5 is steel.

The same rules apply to the linking of attributes as to the linking of an entity to an attribute.

Example

The architecture shown in Figure 1 together with the functionality described with reference to Figures 2 and 3 can be used with advantage to provide a code breaker and an example of code breaker machine architecture is shown in Figure 5.

There is an inherent problem with employing conventional digital computers to crack encrypted code. The conventional method is to use a plurality of code cracking algorithms which are coded into the computer and then the computer

number crunches until it achieves a solution, if possible. A problem with this method is that there are a large number of data combinations that the computer needs to investigate and so if it starts in the right part of the checking sequence, it could reach a solution relatively quickly whereas if it starts spuriously in the wrong part of the solution space, the solution may take much longer to achieve.

In accordance with the invention, this inefficiency is improved by using additional processing techniques on the signals in different formats in order to provide the computer with an indication of where to start looking for a solution. This minimises the random nature of how long the digital computer takes to break code. Conventional code breaking algorithms are run on processor/filter combinations 4a/5a, and additional processing is carried out by processors and filters 4b, 5b and 4c, 5c.

An electrical signal I, which may comprise a signature or password created by the multiplication of two prime numbers, is fed as an input to the element 1, which produces signals in two different formats. In this example, the element 1 comprises an electro-optical modulator, e.g. a laser which receives the input signals I as electrical signals and converts them into corresponding optical pulses. The backplane 2 comprises an electrical line 2a e.g. a coaxial cable which acts as a conduit for the input digital electrical signals I. The modulator 1 produces corresponding digital optical signals that are fed to a second conduit 2b in the form of an optical fibre.

A processor 5b, in the form of a spectral analyser is responsive to the characteristics of the electrical signals in the backplane 2. The analyser 5b is capable of making measurements e.g. from 0-10 GHz with integral filtering functionality thereby providing an inherent adaptive filter 4b. When the element 5b initially senses the electrical coded signal I on the conduit 2a, its filter 4b is set to maximum bandwidth namely 0 - 10GHx. The analyser then takes measurements in relation to the signal frequency, amplitude and power of the signals and upon analysing the measurements, modifies the bandwidth of the filter in order to band limit the spectrum of measurement. This modification of the filter from its maximum bandwidth to a band limited value, constitutes learning and homeostasis, as the

filtering is adapted in response to an analysis of the incoming electrical signal. As long as there is no or little change in the input coded signal from conduit 2a, the filtering will stay in a relatively constant state, but will change in response to changes in the input signal characteristics. Additionally, data from the filter 4a/processor 5a can provide feedback through the electrical wiring to the filter 4b to allow its characteristics to be adaptively changed. Examples of suitable spectrum analysers are HP4395-500MHz, HP4936-1.8GHz, HP8757-40GHz.

The optical signals produced on the conduit 2b are detected by a processor/filter arrangement 5c, 4c capable of performing an optical Fourier transform. The device may comprise a dispersive optical element which has an array of optical receivers which form the output of the filter 4c. When the optical signal is presented to the Fourier transformer, it produces a corresponding pattern in the focal plane of the device which is detected and hence characterised by the optical receiver array 4c. When the coded signal applied to the transformer is modified, the output from the array is consequently changed. The element 4c/5c includes a memory and a simple processing capability to enable particular output patterns for the sensor array 4c to be stored and correlated with particular forms of input code from the optical fibre 2b.

The output from the sensor array 4 comprises an electrical signal 3a which is applied to the electrical conduit 2a.

A conventional digital processor 5a such as a Pentium ™ or similar digital processor with an associated input filter functionality 4a is coupled to the electrical conduit 2a. The filter functionality may provided by software running on the processor or by the provision of an individual processor dedicated to the filtering function. The processor 5a includes a conventional memory and holds a number of different algorithms/programs that can be used to decipher the encrypted code on the conduit 2a. In use, the processor 5a uses the algorithms to attempt to break the code. The processor 5a tries all of the individual programs in a sequence. As an example one of the algorithms may configured as described in "Breaking DES", Paul C Kocher, published by RASA Laboratories in CryptoBytes, the Technical newsletter of

RSA Laboratories, a Division of RSA Data Security Inc, Volume 4, Number 2, Winter 1999. Another algorithm may be as described in "Attacking Elliptic Curve Cryptosystems Using Parallel Pollard rho Method" by Adrian E Escott, Alexander P L Selkirk & Dimitrios Tsapakidis, in the same publication.

The incoming data from the conduit 2a is provided with an identification label by the processor 5a. This label is communicated through the backplane 2 to the other processors 5b, 5c where it is stored and associated with the filtered outputs produced by the filters 4b and 4c. This common label is used to associate the coded signal with the most efficient method employed to crack the code.

Once the processor 5a has identified a solution for the encrypted data, it carries out a sanity check on the solution and possibly refers the solution to a human operator for final checking, on output 6a. Then, assuming that the solution satisfies the criteria, the previously mentioned code label associated with the encrypted signals is associated with the solution itself. This association performs two functions. The first is to allow the machine to learn, so that each time a code is entered into the machine and has already been labelled, then the machine, from its previous experience knows what algorithms are suited to solving it. Thus, the processor 5ais directed to perform algorithmic processing in a particular sub-set of its possible range of possibilities rather than use the complete set of algorithms that are available, thereby speeding up the process.

The processor 5a also carries out a checking of the solution obtained from the code breaking algorithms in order to determine whether a solution has been found or whether further attempts to break the code are required using different algorithms.

An example will now be considered in which the machine shown in Figure 5 is used to crack a signature or password that was created by multiplying two prime numbers. The machine thus is required to determine the two prime numbers from encrypted data comprising the multiplication thereof on input I.

The problem of trying to crack the code with a conventional digital processor requires the processor to number crunch through each and every combination of prime numbers until an appropriate corresponding encrypted code is produced, so as to determine the solution. The speed at which the code will be cracked, is indeterminate as it is a function of where in the number of possibilities available, the algorithm started to check the various combinations.

When the machine of Figure 5 is first switched on, it has no knowledge of the characteristics of the encrypted signal applied to input I or which algorithm should be employed in processor 5a to crack the code. When the first encoded signal is presented to the machine, all of the processors 5a, b, c operate on the signal. As a first operation, the coded signal is characterised by each of the processors and associated with the aforementioned label generated by processor 5a. Once characterised, the machine is able to identify the form of the code, in this case the multiplication of two prime numbers. This may need intervention by a human operator. Having identified the make up of the code, the processor 5a will employ one of a number of number-crunching algorithms to crack the code. The first time that the machine carries out this process, it does not know where to start the algorithm and therefore the process may take along time. Once having cracked the code, the processor 5a will associate the code label with the corresponding solution so as to associate a particular part of the solution space provided by the algorithm with the solution. Each time a new code is presented to the machine, it will start to build a knowledge of the corresponding labels associated with the incoming data which relate to the code characteristics so as to learn where to look for a solution rather than try all possible solutions.

When the machine is initially turned on, instead of just applying a coded signal that requires decoding, it will be possible to take a range of codes which the user has created and therefore for which the solution is known, and use these to teach the machine.

Claims

1. Data processing apparatus comprising:
a backplane for data signals in a plurality of different formats,
a plurality of adaptive filters to receive data signals in respective different formats from the backplane, and
a plurality of processors to receive data derived from the backplane in said different formats respectively, at least one of the processors being operable to process data from one of the filters and being responsive to the outcome of data filtering performed by at least one other of the filters to adapt the processing performed thereby.

2. Apparatus according to claim 1 including a feedback path to adjust filtering characteristics of at least one of the adaptive filters as a function of the outcome of the processing performed by at least one of the processors.

3. Apparatus according to claim 1 or 2 wherein at least one of the processors is operable to carry out processing according to a plurality of different algorithms and to select at least one of them according to the outcome of processing performed by another of the processors.

4. Apparatus according to any preceding claim wherein the backplane includes an first conduit for signals in a first format and a second conduit for signals in a second format.

5. Apparatus according to claim 4 wherein the filters include a first filter to filter the signals in the first conduit and a second filter to filter the signals in the second conduit.

6. Apparatus according to claim 4 or 5 wherein the processors include a first processor to process signals derived from the first conduit and a second processor to process signals derived from the second conduit.

7. Apparatus according to claim 4, 5 or 6 including an input to receive input signals to be processed and to supply the signals to the first and second conduits in the first and second formats.

8. Apparatus according to any one of claims 4 to 7 wherein the first and second conduits are configured to convey optical and electrical signals respectively.

9. A data processing method for data manifested as signals in a plurality of different formats, comprising:

adaptively filtering the data signals in the different formats respectively, and individually processing the signals in said different formats respectively, such as to process data in one of the formats that has been subject to the adaptive filtering, adaptively in response to the outcome of data filtering performed on data in at least one other of the formats.

10. A method according to claim 9 including adjusting the filtering of data in one of the formats as a function of the outcome of the processing performed in another of the formats.

11. A method according to claim 9 or 10 including selecting the processing for data in one of the formats from a plurality of different algorithms according to the outcome of processing performed on the data in another of the formats.

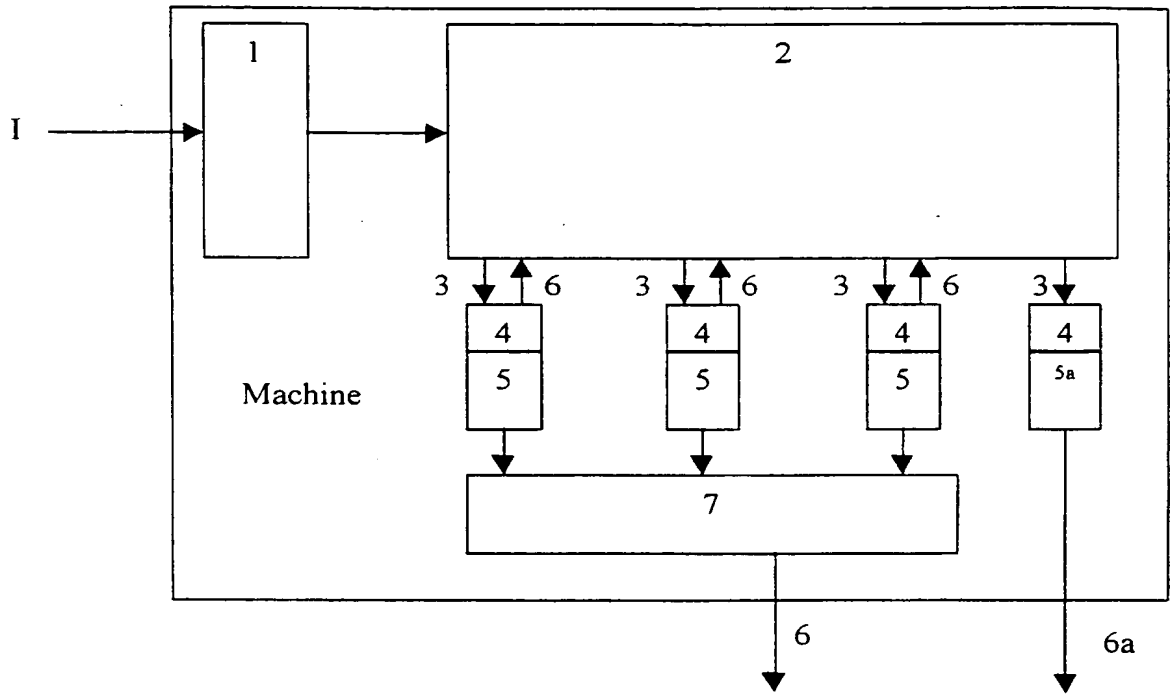

Fig. 1

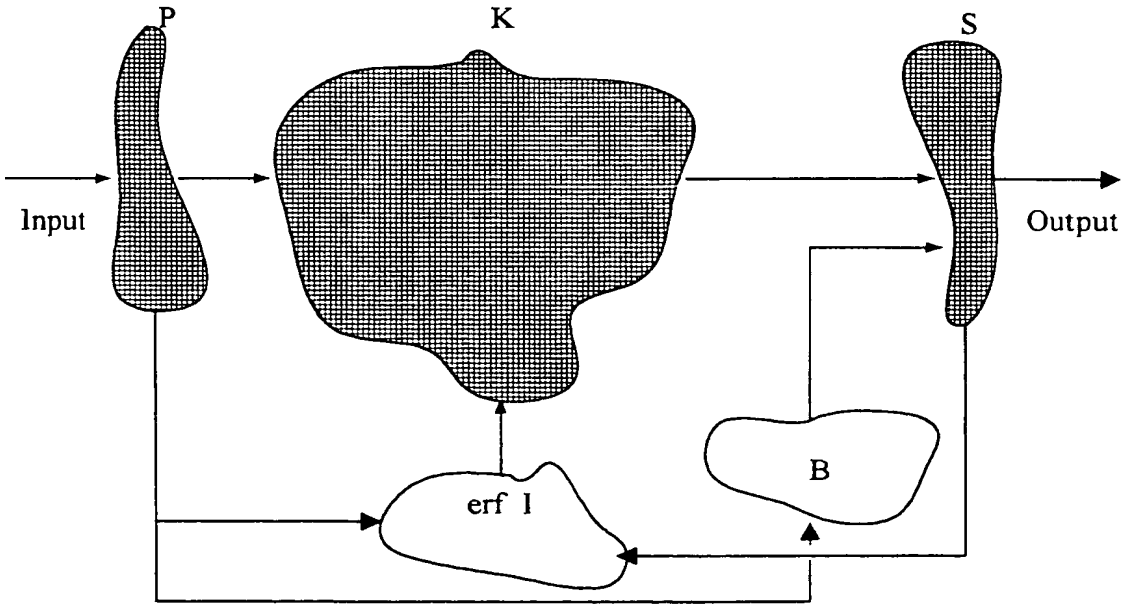

Fig. 2

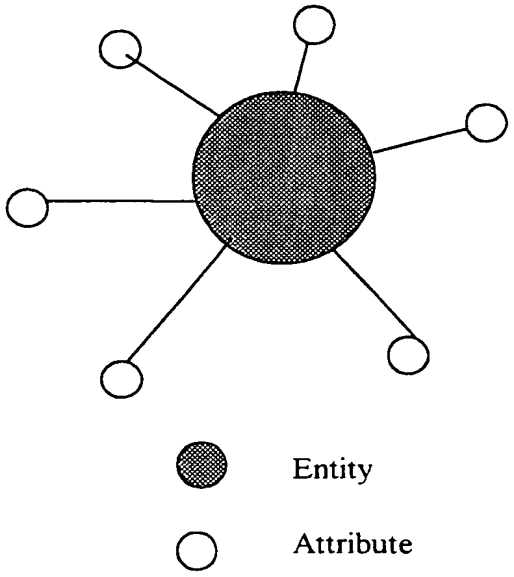

Fig. 3

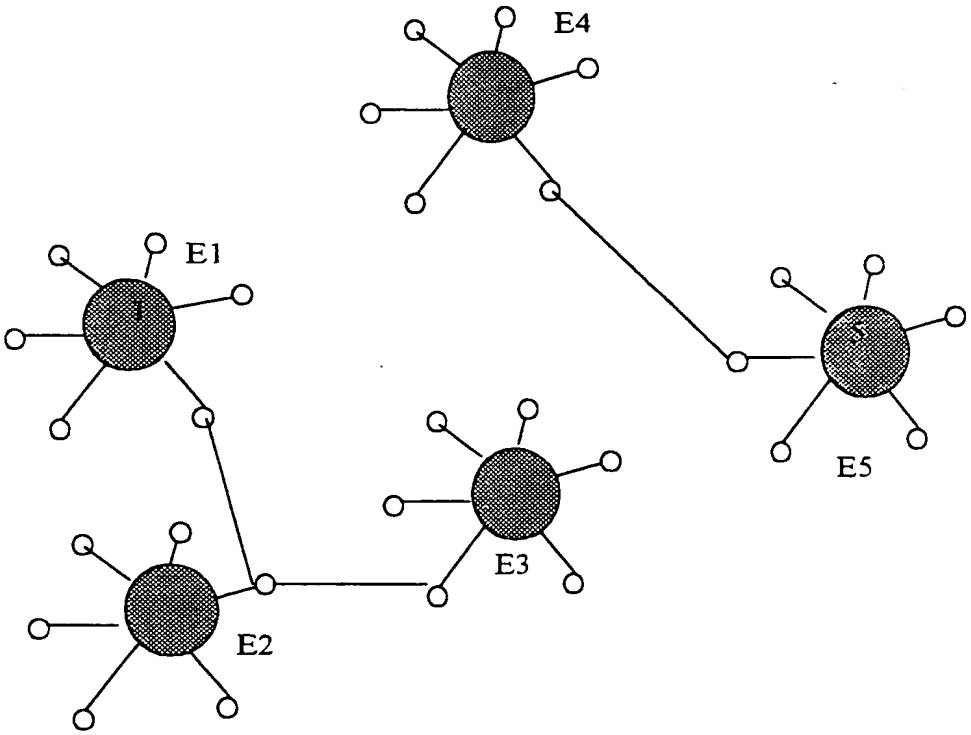

Fig. 4

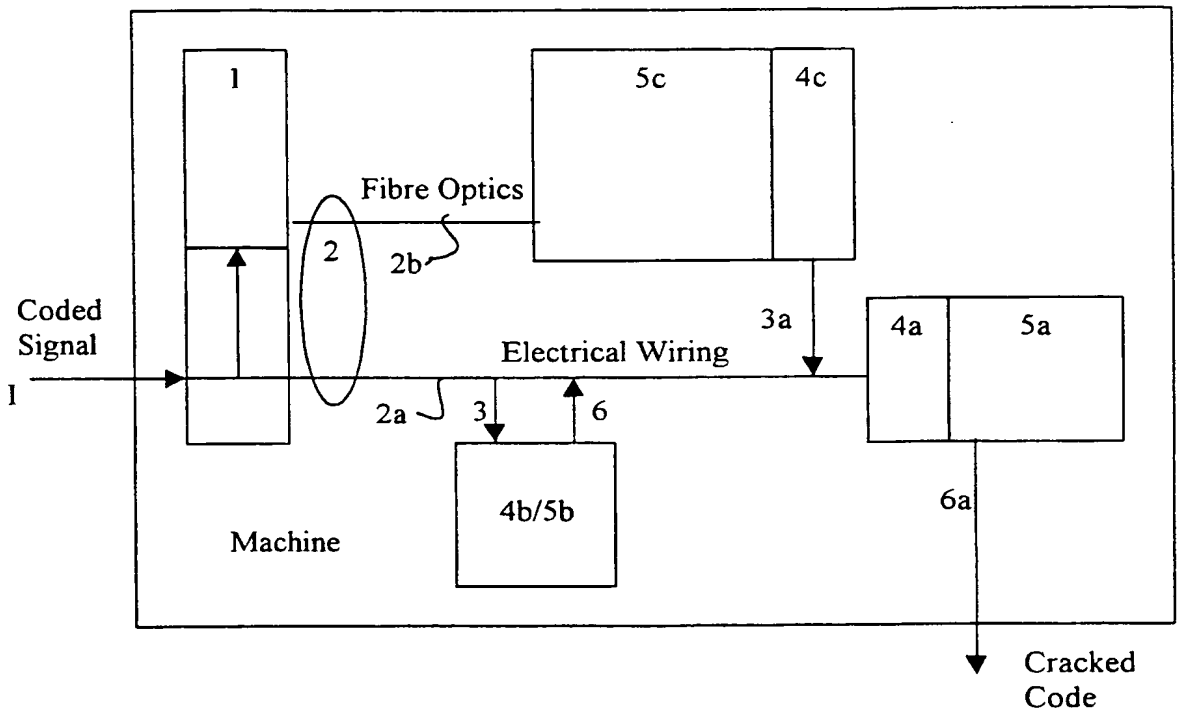
1
5c
4c
Fibre Optics
2
2b
Coded
Signal
1
3a
4a
5a
Electrical Wiring
2a
3
6
4b/5b
6a
Machine
Cracked
Code

Fig. 5

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing: 11 January 2001 (11.01.01)	
International application No.: PCT/GB00/02531	Applicant's or agent's file reference: 03 36091
International filing date: 30 June 2000 (30.06.00)	Priority date: 01 July 1999 (01.07.99)
Applicant: MACKICHAN, John, Cameron et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International preliminary Examining Authority on:

22 September 2000 (22.09.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer: J. Zahra Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

REC'D 15 JAN 2001
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
03 36091		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02531	30/06/2000	01/07/1999
International Patent Classification (IPC) or national classification and IPC G06F15/80		
Applicant BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
22/09/2000	11.01.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Oestergaard, M Telephone No. +49 89 2399 2551

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/02531

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-10 as originally filed

Claims, No.:

1-11 as originally filed

Drawings, sheets:

1-3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-11
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-11
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-11
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Section V:

1 Reference is made to two documents found in the international search. The document D1 = EP-A-0833255 disclosed the use of a plurality of processors optically connected to each other through an optical fibre cable. Each of the plurality of processors further has an optical filter passing through only optical signals of a frequency band that has been assigned to the processor. The document D2 = US-A-5896473 disclosed a common back-plane and a system in conjunction with electrical and optical bus interfaces.

None of the available prior art documents discloses or anticipates the data apparatus of claim 1 or the data processing method of claim 9 of the current application. Claims 1 and 9 rely on the feature of a plurality of adaptive filters to receive data signals in respective different formats from the backplane. The use of adaptive filters is not taught in relation to the backplane as specified in document D2. Neither is a backplane taught in document D1. Claims 1 and 9 further rely on the feature of a processor that is being operable to process data from one of the filtersl, where that processor also being responsive to the outcome of data filtering by at least one other filter in order to adapt its processing in accordance with such second filtered outcome.

The whole set of claims therefore appears to satisfy the requirements of Article 33 PCT with regard to novelty, inventive step and industrial applicability.

Section VII:

2 It would appear preferable to have includee a brief discussion of document D2 in the description in accordance with Rule 5.1(a)(ii,iii) PCT and also to use the two-part form in claim 1. This should apparently have been done by inserting the word characterised by between lines two and three. This is so because document D2 includes the first feature of claim 1.

Section VIII:

3 In the description, page 10, line 18, the word along should apparently have been worded as "a long".

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
03 36091		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 02531	30/06/2000	01/07/1999

Applicant

BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of Invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [ ] as suggested by the applicant.

   [X] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted]B 00/02531

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 'G06F15/80 H04J14/00 G02B6/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06F G02B H04J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC, WPI Data, PAJ, IBM-TDB, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	EP 0 833 255 A (NIPPON ELECTRIC CO) 1 April 1998 (1998-04-01) column 2, line 39 -column 7, line 50; figures 1-4	1,9 2-8,10, 11
Y	US 5 896 473 A (KASPARI DANIEL K) 20 April 1999 (1999-04-20) column 1, line 5 -column 4, line 22; figures 1-4	1,9
A	EP 0 876 019 A (AT & T CORP) 4 November 1998 (1998-11-04) abstract; figure 1	1,2,9,10
A	DE 39 08 786 A (CORDELL STEVE) 3 August 1989 (1989-08-03) column 1, line 3 -column 5, line 34	1,9

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 August 2000	23/08/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Schenkels, P

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted]B 00/02531

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SZYMANSKI T: "A photonic backplane architecture for broadband switching" OPTICAL INTERCONNECTS IN BROADBAND SWITCHING ARCHITECTURES, SAN JOSE, CA, USA, 31 JAN.-1 FEB. 1996, vol. 2692, pages 86-99, XP000853506 Proceedings of the SPIE - The International Society for Optical Engineering, 1996, SPIE-Int. Soc. Opt. Eng, USA ISSN: 0277-786X page 86, line 1 -page 93, line 19	1,9

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Info on patent family members

International Application No
P[redacted]GB 00/02531

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0833255 A	01-04-1998	JP 10105528 A	24-04-1998
		CA 2216579 A	30-03-1998
US 5896473 A	20-04-1999	NONE	
EP 0876019 A	04-11-1998	US 6016212 A	18-01-2000
		CN 1199866 A	25-11-1998
		JP 10327129 A	08-12-1998
DE 3908786 A	03-08-1989	NONE	